Motivation:

Repeated precise leveling surveys carried during the past decade point to an instability of the nodal points in the leveling network in the southwest part of Israel.

Goal:

Modeling the regional and the local vertical movement of points.

Operation:

Intensive GPS monitoring campaigns over a period of one year.

The Stability of Nodal Points in the Leveling Network in the Southwest Part of Israel

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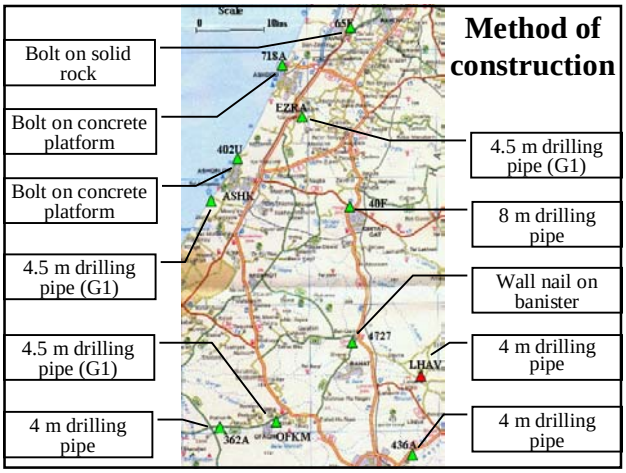
Method of construction



Map of the monitoring area and the network points

Summery of the nine monitoring campaigns

Monitoring Number	Average GPS day	Degrees of freedom	$\hat{m}_0^2$
1	011-2002	117	1.041
2	067-2002	120	0.932
3	127-2002	120	1.003
4	162-2002	117	1.039
5	211-2002	111	0.940
6	246-2002	108	0.983
7	296-2002	114	1.071
8	345-2002	120	1.014
9	038-2003	135	1.011

Field data collection

Receiver: Trimble (L1/L2)
Number of receivers: 4 (3×4000SSE, 1×4000SSI)
Number of sessions: 5
Duration of session: 4.5 hours
Epoch interval: 1 5 sec.
Number of monitoring sessions: 9

The deformation model

Two deformation models were tested to describe the vertical position of a point relative to time:

Linear motion,

$$h = h_0 + \dot{h}\Delta t$$

Swelling and shrinking dynamic model,

$$h = h_0 + \dot{h}\Delta t - \frac{cT}{2\pi}\cos\left(\frac{2\pi}{T}\Delta t\right)$$

The accuracy of the network points in a local horizon system in the free net solution

Point name	Accuracy (1σ) [m]		
	average	*minimum*	*maximum*
LHAV	0.0046	0.0036	0.0073
436A	0.0075	0.0054	0.0103
362A	0.0069	0.0049	0.0096
OFKM	0.0067	0.0049	0.0093
4727	0.0069	0.0048	0.0106
ASHK	0.0058	0.0045	0.0083
402U	0.0062	0.0051	0.0088
040F	0.0074	0.0054	0.0104
065F	0.0063	0.0043	0.0098
718A	0.0058	0.0044	0.0089
EZRA	0.0057	0.0043	0.0091

The linear motion model:

Reference system	model noise	$\hat{m}_0^2$	$F_{(0.05,d,r)}$	k	H_0
All Points	152.0	1.066	1.83	1.40	accepted

There was no linear movements during the measurement campaigns

Two-Steps analysis

First Step:
Epoch by epoch data processing

Second Step:
Deformation analysis

Statistical tests are applied for estimating the correspondence of the motion model

Defined datum points

$$F_{(0.05,d,r)} = 1.94 > 0.63 = k$$

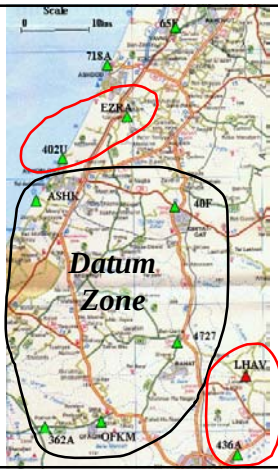
H_0 is accepted

the 5 datum points are stable

The swelling and shrinking model:

Reference system	model noise	$\hat{m}_0^2$	$F_{(0.05,d,r)}$	k	H_0
All Points	101.4	1.031	1.57	3.15	rejected

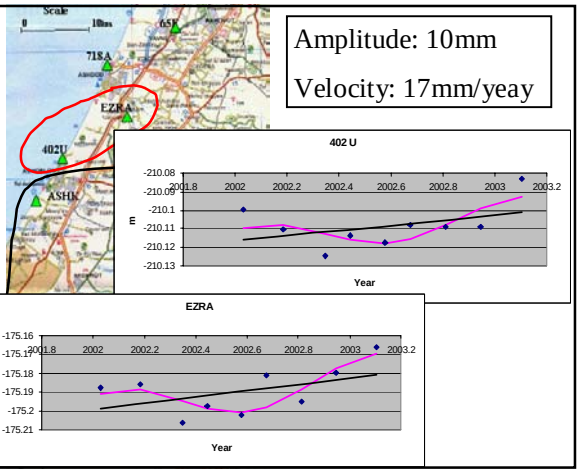
Swelling and shrinking movements occurred during the measurement campaigns

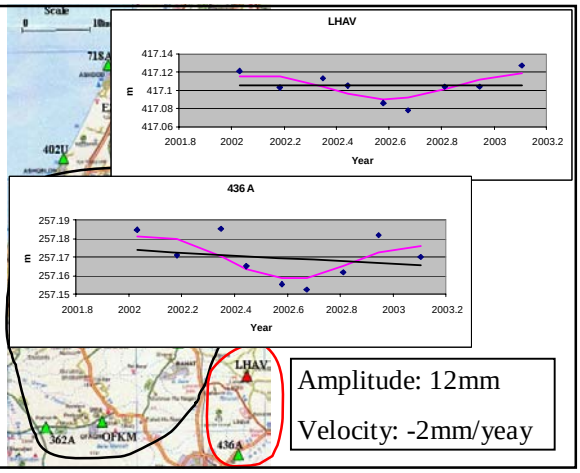


Relative movements

The weight constraints solution of the swelling and shrinking model, relative to the datum points

Point name	h_0 [m]	σ_{h_0} [m]	$\dot{h}$ [m/year]	$\sigma_{\dot{h}}$ [m/year]	c [m/year]	σ_c [m/year]
LHAV	417.103	0.0031	0.0022	0.0060	-0.0868	0.0168
436A	257.172	0.0039	-0.0060	0.0080	-0.0646	0.0214
362A	-29.659	0.0030	-0.0013	0.0059	0.0127	0.0163
OFKM	48.489	0.0029	0.0007	0.0056	0.0005	0.0155
4727	183.527	0.0031	0.0028	0.0067	-0.0192	0.0178
ASHK	-186.731	0.0026	0.0013	0.0055	0.0239	0.0150
402U	-210.117	0.0040	0.0152	0.0078	-0.0551	0.0213
040F	-15.626	0.0039	-0.0034	0.0078	-0.0179	0.0203
065F	-254.655	0.0043	0.0165	0.0084	-0.0339	0.0220
718A	-285.590	0.0041	0.0119	0.0079	-0.0346	0.0213
EZRA	-175.199	0.0040	0.0189	0.0077	-0.0673	0.0210





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